



Repair and Replacement of Trunnion Anchor Rods

Problem

A number of Corps dams have experienced failures of individual trunnion anchor prestressed rods. These failures have the potential to compromise the structural integrity of the trunnion anchorage and result in the loss of capability of the spillway gate to maintain and regulate upper pool levels. Failure of multiple rods in an anchorage could result in catastrophic failure of the anchorage and the support spillway gate. These failures demonstrate a need to develop repair and replacement procedures for trunnion anchor prestressed rods. The primary causes of failed rods from metallurgical reports are environmentally assisted cracking or stress corrosion cracks and low fracture toughness.



Approach

The primary objective of this effort is to develop repair and replacement procedures for anchor rods. Failure of the corrosion protection system is suspected to have contributed to environmentally-assisted cracking. Field replacement of the corrosion protection system is another major objective. A procedure to replace the corrosion protection system and/or rods is being developed. A test bed has been fabricated to test and demonstrate these procedures. Analytical models will be developed to analyze the unloading of prestressing force resulting from rod failures, as well as the detensioning and retensioning of rods during repair and/or replacement. Finally, guidance will be developed for replacement procedures. These procedures could also be applied to rods that have been determined to contain defects. A fracture mechanics analysis will also be conducted to determine the relationship between fracture toughness and tolerable flaw size.

Products

A repair scheme for replacing rods and their corrosion protection system for non-grouted construction is the primary product. Guidance and procedures will be developed for replacement of failed prestressed rods. Being developed are tools to analyze the prestressing force resulting from detensioning and retensioning of rods during repair and/or replacement, as well as to provide a means to analyze trunnion anchorages with failed rods. Documentation of the proposed replacement/repair scheme and the analytical work will be provided in the final report along with the fracture mechanics analysis. The analytical models will be available for District users.

Benefits

The analytical tools and repair and replacement guidance will provide dam operators with tools to assess structural integrity of trunnion anchorages that have failed rods and to develop repair plans based on the scheme and procedure developed. The fracture mechanics analysis will have multiple benefits, including quantifying flaw sizes for researchers developing flaw detection procedures, and establishing minimum fracture toughness requirements for prestressing rods for a given flaw size. It is expected that the proposed repair schemes will be more economical than present proposed schemes. The fracture analysis has the potential to lead to the reduction of future failures by quantifying minimum toughness requirements for anchor prestressed rods.

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